PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-298022
(43)Date of publication of application : 25.10.1994

(51)Int.Cl. B60R 21/00
B60T 7/12

(21)Application number : 05-081815
(22)Date of filing : 08.04.1993
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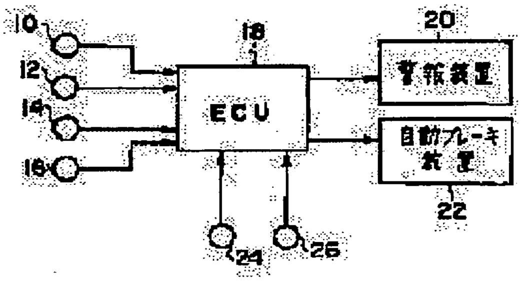
(54) REAR-END COLLISION PREVENTING DEVICE FOR VEHICLE

(57)Abstract:

PURPOSE: To prevent a brake from being operated at an unexpected timing efficiently while a vehicle driver attempts to prevent rear-end collision by means of steering operation in a rear-end collision prevention device for a vehicle provided with an automatic brake device.

CONSTITUTION: Detection signals from a vehicle speed sensor 10, an acceleration sensor 12, a distance measuring sensor 14, a doppler sensor 16 are supplied to an ECU 18. The EUC 18 computes the first inter-vehicle distance XB which permits rear-end collision to be prevent by braking and the second inter-vehicle distance XS which permits rear-end collision to be prevented by means of steering operation based on vehicle speed, relative speed, and an inter vehicle distance. When the detected inter-vehicle distance Δx is more than the second inter-vehicle distance XS even if it is less than the first inter-vehicle distance XB, rear-end collision is prevented by means of a driver's steering operation without operating an automatic brake device 22. The automatic brake device 22 is operated for the first time only when the inter-vehicle distance Δx is less than XB, XS, so it is possible to inhibit the automatic brake device 22 from being operated at an unexpected timing.



LEGAL STATUS

[Date of request for examination]	05.03.1998
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3104463
[Date of registration]	01.09.2000
[Number of appeal against examiner's decision of rejection]	

[Date of requesting appeal against examiner's decision of rejection]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the equipment which has the automatic braking system which operates a brake automatically, when the distance between two cars with the rear-end collision arrester for vehicles, especially a precedence vehicle becomes below predetermined distance.
[0002]
[Description of the Prior Art] The equipment which the radar installation which various equipments are conventionally developed and carried to plan the safe disposition top at the time of a vehicles run, and was carried in vehicles detects the distance between two cars with a precedence vehicle, an alarm is emitted [equipment] when there is possibility of a collision, or operates a brake automatically is also one of them.
[0003] For example, in the distance-between-two-cars watch system indicated by JP,60-91500,A, a radar means to detect the distance between two cars and relative velocity with a precedence vehicle, and a speed-detection means to detect the travel speed of a self-vehicle are established, a danger index is computed based on each detecting signal, and the composition which performs drive control of a brake according to this danger index is proposed.
[0004]
[Problem(s) to be Solved by the Invention] However, dangerous evaluation of the distance between two cars with a precedence vehicle was only performed in this way, with the composition which operates a brake according to the evaluation, it did not necessarily agree to an actual operation feeling, but there was a problem on which a brake operates automatically to unexpected timing.
[0005] That is, when the distance between two cars with a precedence vehicle becomes short and an operator senses the risk [vehicle / precedence] of a rear-end collision in actual operation, by operating a brake and slowing down, whether a rear-end collision is prevented and by operating a steering and making a lane change, it will judge whether a rear-end collision is prevented in an instant, and either will be operated. Although rear-end collision prevention according [vehicles] to brakes operation is effective at the time of a low-speed run, since a stopping distance increases at the time of a high-speed run, the lane change by steering operation becomes effective in rear-end collision prevention from brakes operation rather. Therefore, although an operator is going to prevent a rear-end collision with a precedence vehicle by steering operation at the time of a vehicles high-speed run, with the composition which operates a brake uniformly like composition before, only corresponding to the distance between two cars with a precedence vehicle, a brake will operate to the timing which is not expected although steering operation tends to perform rear-end collision prevention, and an operation feeling will get worse.
[0006] Furthermore, with the composition which aims at rear-end collision prevention by brake operation uniformly in this way, when a consecutiveness vehicle exists, for example, the distance between two cars with a consecutiveness vehicle will decrease by the brake operation of a self-vehicle, and a problem with the increasing danger [vehicle / consecutiveness] of a rear-end collision will also be

produced.
[0007] the rear-end collision arrester for vehicles which this invention is made in view of the technical problem which the above-mentioned conventional technology has, and the purpose does not worsen an operation feeling, and can prevent effectively a rear-end collision with a precedence vehicle and a rear-end collision with a consecutiveness vehicle is offered -- it is in things
[0008]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the rear-end collision arrester for vehicles of this invention A self-vehicle speed detection means and a distance-between-two-cars detection means to detect the distance between two cars with a precedence vehicle, An operation means to compute the 2nd distance between two cars which can prevent the rear-end collision to a precedence vehicle by the 1st distance between two cars and steering operation in which the rear-end collision to a precedence vehicle can be prevented by the brake based on a relative-speed-detector means to detect relative velocity with a precedence vehicle, the self-vehicle speed and the distance between two cars, and relative velocity, When the detected distance between two cars turns into the 1st distance between two cars of the above, and the 2nd less than distance between two cars, it is characterized by having the control means which operate a brake automatically.
[0009]
[Function] Thus, the rear-end collision arrester for vehicles of this invention computes the 2nd distance between two cars in which rear-end collision prevention is possible by the 1st distance between two cars in which rear-end collision prevention by brakes operation is possible, and steering operation, and only when the detected distance between two cars turns into the 1st and the 2nd less than distance between two cars, it operates a brake automatically.
[0010] Even if the direction of the 2nd distance between two cars becomes short and the distance between two cars with a precedence vehicle generally becomes short rather than the 1st distance between two cars at the time of a self-vehicle high-speed run, it becomes possible to aim at rear-end collision prevention by steering operation. Therefore, under such a situation, a vehicles operator is going to aim at rear-end collision prevention by steering operation rather than brakes operation. Since a brake operation is carried out for the first time when according to the rear-end collision arrester for vehicles by this invention a brake operation is not carried out more than in the case of the 2nd distance between two cars and it becomes the 1st and the 2nd less than distance between two cars, even if the detected distance between two cars turned into the 1st less than distance between two cars, it can prevent a brake operating automatically to the timing which an operator does not expect, and rear-end collision prevention as an intention of an operator can be aimed at. Moreover, in this invention, since a brake is not automatically operated by steering operation in the distance in which rear-end collision prevention is possible, reduction of the distance between two cars with the consecutiveness vehicle by sudden braking can also be prevented effectively, and rear-end collision prevention with a consecutiveness vehicle can also be aimed at.
[0011]
[Example] Hereafter, the suitable example of the rear-end collision arrester for vehicles concerning this invention is explained, using a drawing.
[0012] The configuration block view of this example is shown in drawing 1 . The vehicle speed sensor 10, an acceleration sensor 12, the ranging sensor 14, and the Doppler sensor 16 are formed in the predetermined position of vehicles, respectively, and the distance between two cars with the acceleration of the self-vehicle speed and a self-vehicle and a precedence vehicle and relative velocity with a precedence vehicle are detected. The detecting signal from each sensor is supplied to an electronic control ECU 18. In addition, time differential of the distance between two cars with the precedence vehicle which could use laser radar equipment etc. as a ranging sensor 14, could carry out time differential of the self-vehicle speed detected by the vehicle speed sensor 10, and could detect acceleration instead of being an acceleration sensor, and was detected by the ranging sensor 14 instead of the Doppler sensor 16 can be carried out, and relative velocity with a precedence vehicle can also be detected.

[0013] The I/O Port which inputs the detecting signal from each sensor, ROM in which the operation program was stored, CPU which performs data processing later mentioned according to this program, RAM which memorizes the result of an operation are built in, it is based on the self-vehicle speed, the relative velocity, and the distance between two cars which were detected, and ECU18 is the 1st distance between two cars xB in which rear-end collision prevention [by the brake] with a precedence vehicle is possible. And the 2nd distance between two cars xS in which rear-end collision prevention [by steering operation] with a precedence vehicle is possible And the distance between two cars detected by the ranging sensor 14, these [1st] and the 2nd distance between two cars xB, and xS It is the composition of performing size comparison, and operating an alarm 20 according to a comparison result, or operating automatic-braking-system equipment 22, and aiming at rear-end collision prevention. In addition, when the detecting signal from an accelerator SW24 and a brake SW26 was also supplied to ECU18 and a vehicles operator operated an accelerator, while canceling the operation of automatic-braking-system equipment 22, when a vehicles operator operates a brake spontaneously, automatic-braking-system equipment 22 is operated and is slowed down.

[0014] Hereafter, operation of this ECU18 is explained more to a detail using the flow chart of drawing 2 . In addition, the expedient top of explanation and each variable are defined as follows.

[0015] a0 : Acceleration tau of a self-vehicle : Time delay b0 : Lateral acceleration a1 : Acceleration v0 of a precedence vehicle : Self-vehicle-speed deltav: Distance-between-two-cars **** with a relative-velocity deltax:precedence vehicle, a0, tau, and b0 It initializes (S101). And the detecting signal from each sensors 10-16 is inputted. That is, deltav is inputted from an acceleration sensor 12 to the vehicle speed sensor 10 to v0, a0, delta x from the ranging sensor 14, and the Doppler sensor 16 (S102). In addition, acceleration a1 of a precedence vehicle Acceleration a0 of a self-vehicle It is computed by a1 =a0-d(deltav)/dt from relative-velocity deltav.

[0016] And ECU18 is based on each [these] detecting signal, and is the 1st distance between two cars xB in which rear-end collision prevention by the brake is possible. And the 2nd distance between two cars xS in which rear-end collision prevention by steering operation is possible It computes (S103, S104).

[0017] The 1st distance between two cars xB In consideration of possibility of clashing from behind while possibility of clashing from behind after a precedence vehicle's stopping, and a precedence vehicle slow down, it is computed as follows.

[0018]

[Equation 1]

$$x_B = \left(v_0\tau + \frac{1}{2}\frac{v_0^2}{a_0}\right) - \frac{1}{2}\frac{(v_0-\Delta v)^2}{a_1} + \Delta x \quad \left(v_0 < a_0\frac{\Delta v + a_1\tau}{a_0 - a_1}\right)$$

[Equation 2]

$$x_B = v_0 t_0 - \frac{1}{2}a_0(t_0-\tau)^2 - \left\{(v_0-\Delta v)t_0 - \frac{1}{2}a_1 t_0^2\right\} + \Delta x \quad \left(v_0 \geq a_0\frac{\Delta v + a_1\tau}{a_0 - a_1}\right)$$

However, it is t0 =(deltav+a0 tau)/(a0-a1).

[0019] The 2nd distance between two cars xS in which rear-end collision prevention by steering operation is possible on the other hand A self-vehicle is speed v0 to a stopped precedence vehicle. It approaches and is lateral acceleration b0 after Time tau from a certain point. Supposing the case where it avoids, in order not to clash against a precedence vehicle from behind by this steering operation, it is computed as the minimum distance between two cars which should carry out a steering operation start. The physical relationship of the precedence vehicle 200 and the self-vehicle 100 is shown in drawing 3 , and they are Time tau and the distance R1 by which steering operation is actually started. And the 2nd distance between two cars xS to find The relation is shown. In addition, breadth of a car and the width of road are set as l. As shown in drawing 4 , when tracing of the self-vehicle when performing steering operation is approximated on the periphery of a radius r, it is [Equation 3] from a geometric relation.

$$R_1 = \sqrt{4\frac{v_0^2}{b_0}\ell - \ell^2}$$

It becomes. Therefore, the 2nd distance between two cars xS found from drawing 3 [Equation 4]

$$x_S = v\cdot\tau + \sqrt{4\frac{v_0^2}{b_0}\ell - \ell^2}$$

It becomes.
[0020] xB at the time of being referred to as a0 =1.0G, tau= 0, a1 =0.5G, and b0 =0.8G at drawing 5 xS It is shown. In drawing 5 , a horizontal axis is v0 (self-vehicle speed), and a vertical axis is distance. Moreover, deltav, i.e., relative velocity, is used for the parameter. It sets to the field where the self-vehicle speed is high-speed when relative velocity is km [50 / //h] and 60 km/h, and is xB. xS It turns out that it has reversed. Therefore, with the composition which operates a brake when the distance between two cars only turns into dangerous distance like before, even if it does not carry out a brake operation in a high-speed region, in spite of being the distance which can carry out rear-end collision prevention only in steering operation, a brake operation will be carried out. Then, it sets to this example and is the 1st distance between two cars xB. xS The detected distance between two cars delta x is compared the smaller one (S105). And xB xS When the distance between two cars delta x is larger than the smaller one, automatic-braking-system equipment 22 is not operated (S106). However, xB and xS When the distance between two cars delta x becomes small rather than any or the larger one, an alarm 20 is operated to give an operator cautions and an alarm is given. On the other hand, the distance between two cars delta x is xB and xS. When it becomes smaller than the smaller one, automatic-braking-system equipment 22 is operated for the first time, and rear-end collision prevention is aimed at (S107).
[0021] In addition, it sets to a low-speed machine and is xB. xS Since it is small, the distance between two cars delta x is xB. When it becomes the following, automatic-braking-system equipment 22 will operate.
[0022] Thus, since an automatic braking system is not operated by steering operation in this example when rear-end collision prevention is possible, and rear-end collision prevention is aimed at by steering operation, while preventing an automatic braking system operating to the timing which an operator does not expect and preventing aggravation of an operation feeling, it can prevent the distance between two cars with a consecutiveness vehicle decreasing rapidly by rapid brakes operation, and rear-end collision prevention can be planned effectively.
[0023]
[Effect of the Invention] Without worsening an operation feeling according to the rear-end collision arrester for vehicles of this invention, as explained above, rear-end collision prevention with a precedence vehicle and a consecutiveness vehicle can be aimed at, and the safety of a vehicles run can be raised further.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the configuration block view of one example of this invention.
[Drawing 2] It is the processing flow chart of ECU in this example.
[Drawing 3] It is calculation explanatory drawing of the 2nd distance between two cars in this example.
[Drawing 4] It is calculation explanatory drawing of the 2nd distance between two cars in this example.
[Drawing 5] It is the graphical representation showing the relation of the 1st distance between two cars and the 2nd distance between two cars in this example.
[Description of Notations]
10 Vehicle Speed Sensor
12 Acceleration Sensor
14 Ranging Sensor
16 Doppler Sensor
18 ECU
20 Alarm
22 Automatic-Braking-System Equipment
24 Accelerator SW
26 Brake SW

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CLAIMS

[Claim(s)]
[Claim 1] The rear-end collision arrester for vehicles characterized by providing the following Self-vehicle speed detection means A distance-between-two-cars detection means to detect the distance between two cars with a precedence vehicle A relative-speed-detector means to detect relative velocity with a precedence vehicle An operation means to compute the 2nd distance between two cars which can prevent the rear-end collision to a precedence vehicle by the 1st distance between two cars and steering operation in which the rear-end collision to a precedence vehicle can be prevented by the brake based on the self-vehicle speed, the distance between two cars, and relative velocity, and control means which operate a brake automatically when the detected distance between two cars turns into the 1st distance between two cars of the above, and the 2nd less than distance between two cars

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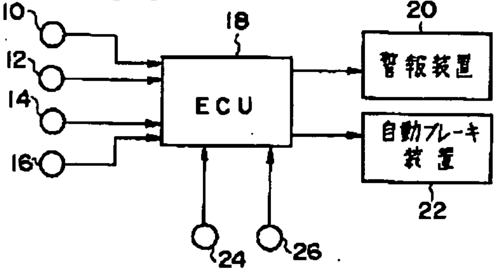
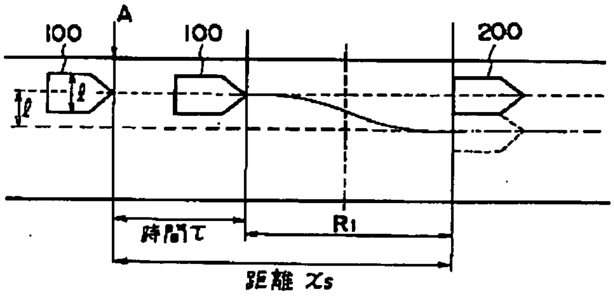
DRAWINGS

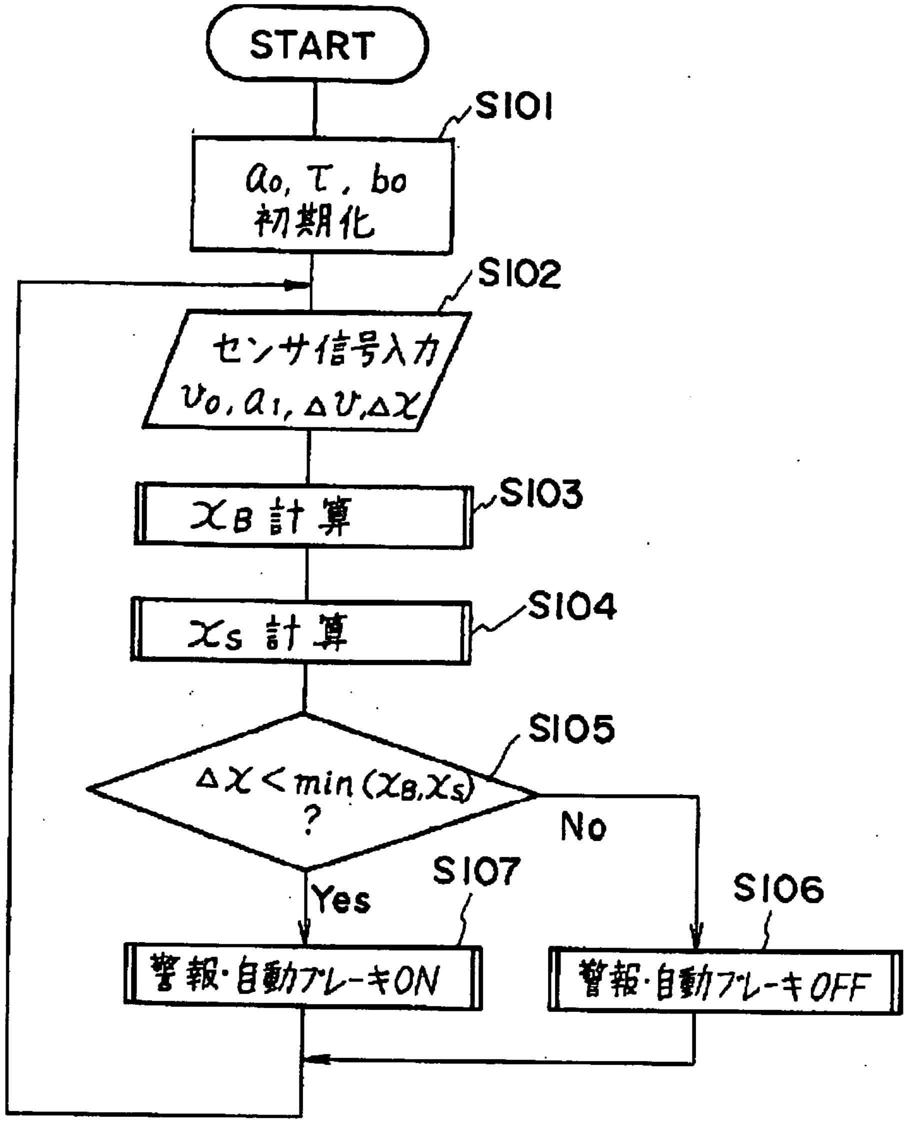
[Drawing 1]



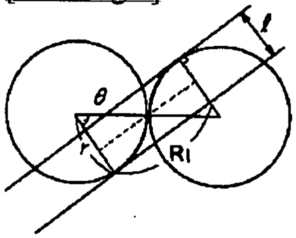
[Drawing 3]



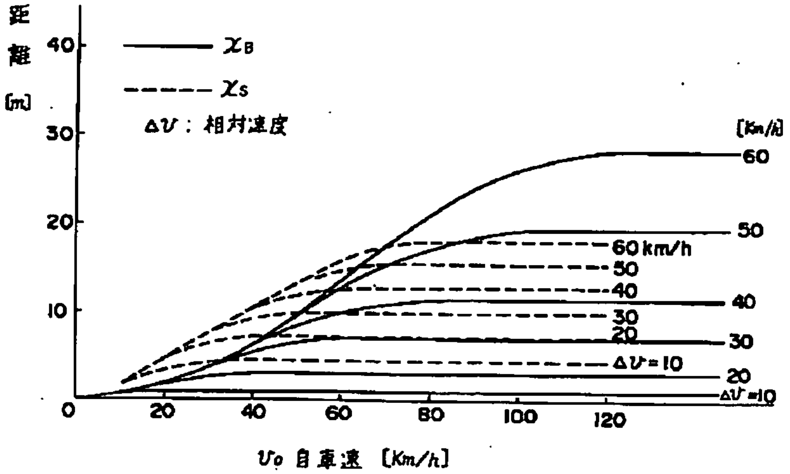
[Drawing 2]



[Drawing 4]



[Drawing 5]



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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平6－298022

(43)公開日　平成６年(1994)10月25日

(51)Int.Cl.^{5}	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ６０Ｒ　21/00	Ｃ	8012－3D		
Ｂ６０Ｔ　7/12	Ｃ	9237－3H		

審査請求　未請求　請求項の数１　ＯＬ　（全　６　頁）

(21)出願番号　特願平5－81815

(22)出願日　平成５年(1993)４月８日

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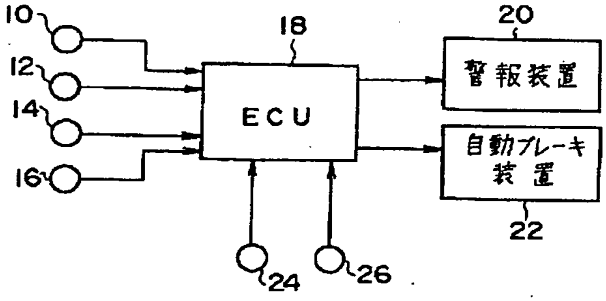
(54)【発明の名称】　車両用追突防止装置

(57)【要約】

【目的】　自動ブレーキ装置を備える車両用追突防止装置において、車両運転者がステアリング操作により追突防止を図ろうとしているときに不要なタイミングでブレーキ作動することを有効に防止する。

【構成】　車速センサ１０、加速度センサ１２、測距センサ１４、ドプラセンサ１６からの検出信号はＥＣＵ１８に供給される。ＥＣＵ１８は自車速、相対速度、及び車間距離に基づきブレーキにより追突防止可能な第１車間距離x_B及びステアリング操作により追突防止可能な第２車間距離x_Sを算出する。検出された車間距離Δxが第１車間距離x_B以下であっても第２車間距離x_Sより大きい場合には自動ブレーキ装置２２を作動させず、運転者のステアリング操作により追突防止を図る。車間距離Δxがx_B、x_S以下となった場合に初めて自動ブレーキ装置２２を作動させるので、予期しないタイミングで自動ブレーキ装置２２が作動しない。



【特許請求の範囲】

【請求項１】　自車速検出手段と、
先行車との車間距離を検出する車間距離検出手段と、
先行車との相対速度を検出する相対速度検出手段と、
自車速、車間距離及び相対速度に基づきブレーキにより先行車への追突を防止できる第１車間距離及びステアリング操作により先行車への追突を防止できる第２車間距離を算出する演算手段と、
検出された車間距離が前記第１車間距離及び第２車間距離以下となった時にブレーキを自動作動させる制御手段と、
を有することを特徴とする車両用追突防止装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は車両用追突防止装置、特に先行車との車間距離が所定距離以下となった時にブレーキを自動作動させる自動ブレーキを有する装置に関する。

【０００２】

【従来の技術】従来より、車両走行時の安全性向上を図るべく種々の装置が開発、搭載されており、車両に搭載したレーダ装置により先行車との車間距離を検出し、衝突の可能性がある場合に警報を発し、あるいはブレーキを自動作動させる装置もその一つである。

【０００３】例えば、特開昭６０－９１５００号公報に開示された車間距離警戒システムでは、先行車との車間距離及び相対速度を検出するレーダ手段と、自車の走行速度を検出する速度検出手段を設け、各検出信号に基づいて危険度指数を算出し、この危険度指数に従ってブレーキの駆動制御を行う構成が提案されている。

【０００４】

【発明が解決しようとする課題】しかしながら、このように単に先行車との車間距離の危険評価を行い、その評価に応じてブレーキを作動させる構成では、必ずしも実際の運転フィーリングに合致せず、予期しないタイミングで自動的にブレーキが作動してしまう問題があった。

【０００５】すなわち、実際の運転操作において、先行車との車間距離が短くなり、運転者が先行車との追突の危険を感じる場合、ブレーキを作動させて減速することにより追突を防止するか、あるいはステアリングを操作して車線変更することにより追突を防止するかを瞬時に判断し、いずれかの操作を行うことになる。車両が低速走行時においては、ブレーキ操作による追突防止が有効であるが、高速走行時においては停止距離が増大するため、ブレーキ操作よりもむしろステアリング操作による車線変更が追突防止に有効となる。従って、車両高速走行時においては、運転者はステアリング操作により先行車との追突を防止しようとするが、従来構成のように単に先行車との車間距離に応じて一律にブレーキを作動させる構成では、ステアリング操作により追突防止を行おうとしているにも拘らず予期しないタイミングでブレーキが作動し、運転フィーリングが悪化してしまう。

【０００６】更に、このように一律にブレーキ作動により追突防止を図る構成では、例えば後続車が存在する場合には自車のブレーキ作動により後続車との車間距離が減少し、後続車との追突の危険性が高まる問題も生じてしまう。

【０００７】本発明は上記従来技術の有する課題に鑑みなされたものであり、その目的は運転フィーリングを悪化させず、かつ先行車との追突及び後続車との追突を有効に防止しうる車両用追突防止装置を提供することにある。

【０００８】

【課題を解決するための手段】上記目的を達成するために、本発明の車両用追突防止装置は、自車速検出手段と、先行車との車間距離を検出する車間距離検出手段と、先行車との相対速度を検出する相対速度検出手段と、自車速、車間距離及び相対速度に基づきブレーキにより先行車への追突を防止できる第１車間距離及びステアリング操作により先行車への追突を防止できる第２車間距離を算出する演算手段と、検出された車間距離が前記第１車間距離及び第２車間距離以下となった時にブレーキを自動作動させる制御手段と、を有することを特徴とする。

【０００９】

【作用】このように、本発明の車両用追突防止装置は、ブレーキ操作により追突防止可能な第１車間距離とステアリング操作により追突防止可能な第２車間距離を算出し、検出された車間距離が第１及び第２車間距離以下となった時にのみブレーキを自動作動させるものである。

【００１０】自車高速走行時においては、一般に第１車間距離よりも第２車間距離の方が短くなり、先行車との車間距離が短くなってもステアリング操作により追突防止を図ることが可能となる。従って、このような状況下では車両運転者はブレーキ操作よりもステアリング操作により追突防止を図ろうとする。本発明による車両用追突防止装置によれば、検出された車間距離が第１車間距離以下となっても第２車間距離以上の場合にはブレーキ作動させず第１及び第２車間距離以下となった場合に初めてブレーキ作動させるので、運転者が予期しないタイミングでブレーキが自動作動するのを防ぎ、運転者の意図通りの追突防止を図ることができる。また、本発明においては、ステアリング操作により追突防止可能な距離ではブレーキを自動作動させないので、急制動による後続車との車間距離の減少をも有効に防止し、後続車との追突防止も図ることができる。

【００１１】

【実施例】以下、図面を用いながら本発明に係る車両用追突防止装置の好適な実施例を説明する。

【００１２】図１には本実施例の構成ブロック図が示さ

れている。車速センサ１０、加速度センサ１２、測距センサ１４及びドプラセンサ１６がそれぞれ車両の所定位置に設けられ、自車速、自車の加速度、先行車との車間距離及び先行車との相対速度を検出する。各センサからの検出信号は電子制御装置ＥＣＵ１８に供給される。なお、測距センサ１４としてはレーザレーダ装置等を用いることができ、加速度センサの代わりに車速センサ１０にて検出された自車速を時間微分して加速度を検出しても良く、またドプラセンサ１６の代わり測距センサ１４にて検出された先行車との車間距離を時間微分して先行車との相対速度を検出することもできる。

【００１３】ＥＣＵ１８は各センサからの検出信号を入力するＩ／Ｏポートと演算プログラムが格納されたＲＯＭ、このプログラムに従い後述する演算処理を行うＣＰＵ、演算結果を記憶するＲＡＭ等を内蔵しており、検出された自車速や相対速度及び車間距離に基づきブレーキにより先行車との追突防止可能な第１車間距離x_B 及びステアリング操作により先行車との追突防止可能な第２車間距離x_S を算出する。そして、測距センサ１４にて検出された車間距離とこれら第１、第２車間距離x_B 、x_S との大小比較を行い、比較結果に応じて警報装置２０を作動させ、あるいは自動ブレーキ装置２２を作動させて追突防止を図る構成である。なお、ＥＣＵ１８にはアクセルＳＷ２４及びブレーキＳＷ２６からの検出信号も供給され、車両運転者がアクセルを操作した場合に自動ブレーキ装置２２の作動を解除するとともに、車両運転者がブレーキを自発的に操作した場合に自動ブレーキ装置２２を作動させ減速する。

【００１４】以下、図２のフローチャートを用いてこのＥＣＵ１８の動作をより詳細に説明する。なお、説明の便宜上、各変数は以下のように定義される。

【００１５】a_0 ：自車の加速度
τ ：遅れ時間
b_0 ：横加速度
a_1 ：先行車の加速度
v_0 ：自車速
Δv ：相対速度
Δx ：先行車との車間距離

まず、a_0 、τ 、b_0 を初期化する（Ｓ１０１）。そして、各センサ１０～１６からの検出信号を入力する。すなわち、車速センサ１０からv_0 、加速度センサ１２からa_0 、測距センサ１４からΔx、ドプラセンサ１６からΔvを入力する（Ｓ１０２）。なお、先行車の加速度a_1 は自車の加速度a_0 と相対速度Δvから$a_1 = a_0 - d(\Delta v)/dt$により算出される。

【００１６】そして、ＥＣＵ１８はこれら各検出信号に基づきブレーキにより追突防止可能な第１車間距離x_B 及びステアリング操作により追突防止可能な第２車間距離x_S を算出する（Ｓ１０３、Ｓ１０４）。

【００１７】第１車間距離x_B は先行車が停止後に追突する可能性及び先行車が減速中に追突する可能性を考慮し、以下のように算出される。

【００１８】

【数１】

$$x_B = \left(v_0\tau + \frac{1}{2}\frac{v_0^2}{a_0}\right) - \frac{1}{2}\frac{(v_0-\Delta v)^2}{a_1} + \Delta x \quad \left(v_0 < a_0\frac{\Delta v + a_1\tau}{a_0 - a_1}\right)$$

【数２】

$$x_B = v_0t_0 - \frac{1}{2}a_0(t_0-\tau)^2 - \left\{(v_0-\Delta v)t_0 - \frac{1}{2}a_1t_0^2\right\} + \Delta x \quad \left(v_0 \geqq a_0\frac{\Delta v + a_1\tau}{a_0 - a_1}\right)$$

ただし、$t_0 = (\Delta v + a_0\tau)/(a_0 - a_1)$ である。

【００１９】一方、ステアリング操作により追突防止可能な第２車間距離x_S は、停止している先行車に自車が速度v_0 で接近し、ある地点から時刻τ 後に横加速度b_0 で回避する場合を想定し、このステアリング操作により先行車に追突しないためにステアリング操作開始すべき最小車間距離として算出される。図３には先行車２０及び自車１００の位置関係が示され、また時間τ 、実際にステアリング操作が開始される距離R_1 及び求める第２車間距離x_S の関係が示されている。なお、車幅及び道幅はlに設定されている。ステアリング操作を行った時の自車の軌跡を図４に示されるように半径ｒの円周で近似した場合、幾何学的関係より

【数３】

$$R_1 = \sqrt{4\frac{v_0^2}{b_0}\ell - \ell^2}$$

となる。従って、図３より、求める第２車間距離x_S は、

【数４】

$$x_S = v \cdot \tau + \sqrt{4\frac{v_0^2}{b_0}\ell - \ell^2}$$

となる。

【００２０】図５にはa_0 ＝１．０Ｇ、τ＝０、a_1 ＝０．５Ｇ、b_0 ＝０．８Ｇとした場合のx_B とx_S が示されている。図５において横軸はv_0 （自車速）であり、縦軸は距離である。またパラメータにはΔｖ、すなわち相対速度が用いられている。相対速度が５０ｋｍ／ｈ及び６０ｋｍ／ｈの時には、自車速が高速の領域においてx_B とx_S とが逆転していることがわかる。従って、従来のように単に車間距離が危険距離となった場合にブレーキを作動させる構成では、高速域においてブレーキ作動させせなくてもステアリング操作のみで追突防止できる距離であるにもかかわらず、ブレーキ作動してしまうことになる。そこで、本実施例においては、第１車間距離x_B とx_S の小さい方と検出された車間距離Δｘとを比較している（Ｓ１０５）。そして、x_B とx_S の小さいほうよりも車間距離Δｘが大きい場合には自動ブレーキ装置２２を作動させない（Ｓ１０６）。ただし、x_B 、x_S のいずれか大きいほうよりも車間距離Δｘが小さくなった場合には、運転者に注意を与えるべく警報装置２０を作動させて警報を与える。一方、車間距離Δｘがx_B 、x_S の小さい方より小さくなった場合には、初めて自動ブレーキ装置２２を作動させて追突防止を図る（Ｓ１０７）。

【００２１】なお、低速機においてはx_B がx_S よりも小さいので、車間距離Δｘがx_B 以下となった場合に自動ブレーキ装置２２が作動することになる。

【００２２】このように、本実施例においてはステアリング操作により追突防止可能な場合には自動ブレーキを作動させずステアリング操作により追突防止を図るので、運転者が予期しないタイミングで自動ブレーキが作動することを防いで運転フィーリングの悪化を防止するとともに、急激なブレーキ操作により後続車との車間距離が急減することを防いで有効に追突防止を図ることができる。

【００２３】

【発明の効果】以上説明したように、本発明の車両用追突防止装置によれば、運転フィーリングを悪化させることなく、かつ先行車及び後続車との追突防止を図ることができ、車両走行の安全性を一層向上させることができる。

【図面の簡単な説明】

【図１】本発明の一実施例の構成ブロック図である。

【図２】同実施例におけるＥＣＵの処理フローチャートである。

【図３】同実施例における第２車間距離の算出説明図である。

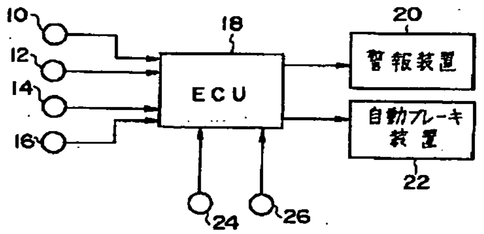
【図４】同実施例における第２車間距離の算出説明図である。

【図５】同実施例における第１車間距離と第２車間距離との関係を示すグラフ図である。

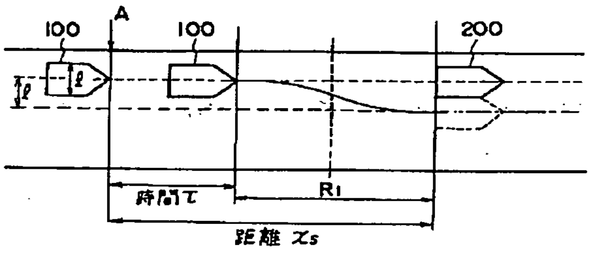
【符号の説明】

１０	車速センサ
１２	加速度センサ
１４	測距センサ
１６	ドプラセンサ
１８	ＥＣＵ
２０	警報装置
２２	自動ブレーキ装置
２４	アクセルＳＷ
２６	ブレーキＳＷ

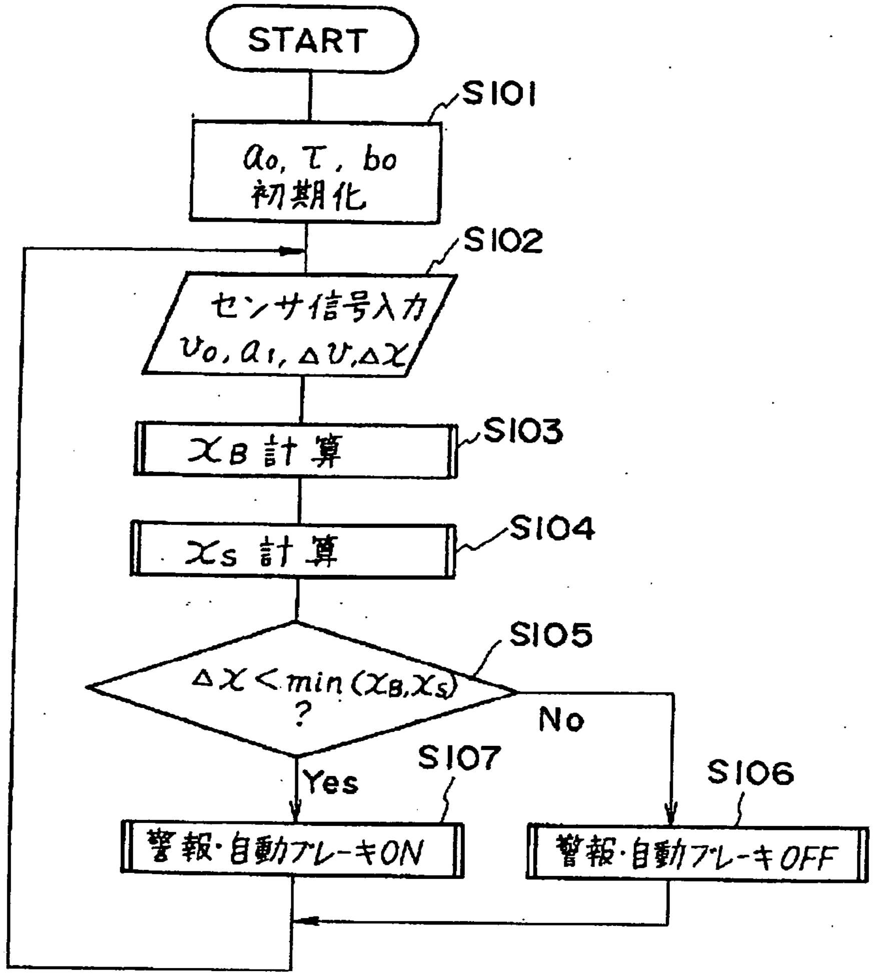
【図１】



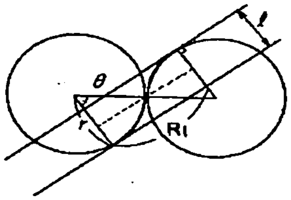
【図３】



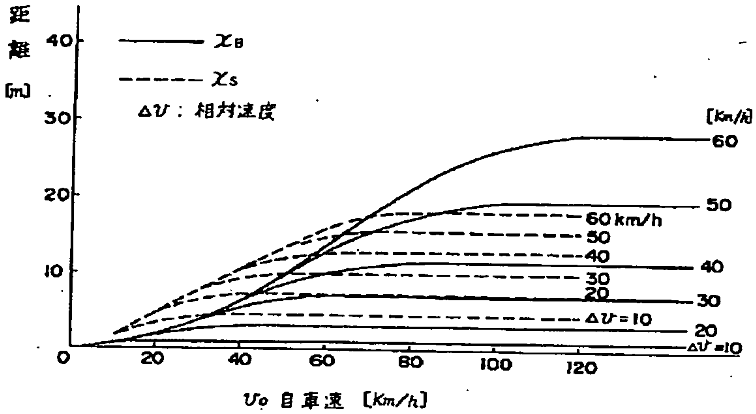
【図2】


START
S101
a_0, τ, b_0
初期化
S102
センサ信号入力
v_0, a_1, Δv, Δx
S103
x_B 計算
S104
x_S 計算
S105
$\Delta x < \min(x_B, x_S)$
?
No
Yes
S107
S106
警報・自動ブレーキON
警報・自動ブレーキOFF

【図4】


ℓ
θ
r
R_1

【図５】


距離
[m]
40
30
20
10
0
x_B
x_S
Δv：相対速度
[Km/h]
60
50
60 km/h
50
40
40
30
20
30
Δv＝10
20
Δv＝10
20
40
60
80
100
120
v_0 自車速 [Km/h]